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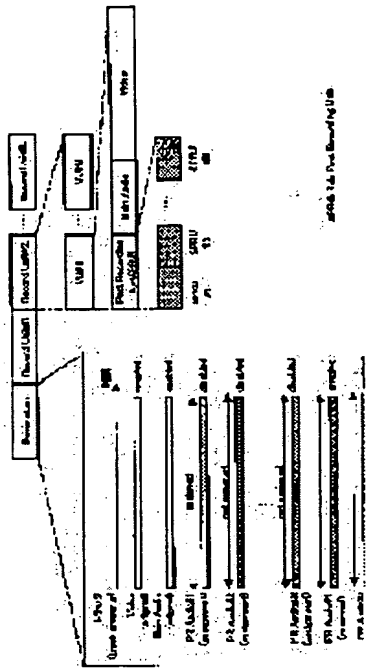
(54) DATA-RECORDING METHOD, DATA RECORDER AND RECORDING MEDIUM

(57)Abstract:
PROBLEM TO BE SOLVED: To enable post-recording from a plurality of user programs.
SOLUTION: In the data-recording method, a first unit constituting of a first area to store a first data constituting of a video or a voice and a second data reproduced synchronous with the first data, and a first program to manage one or more of the first units are recorded on a recording medium. The first program is provided with management information of assignment state of the first area.



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A. Relevance of the Above-identified Document

The following is a partial English translation of exemplary portions of non-English language information that may be relevant to the issue of patentability of the claims of the present application.

B. Translation of the Relevant Passages of the Document

See also the attached English Abstract.

[CLAIMS]

[Claim 1]

A data recording method of recording a first unit and a first program into a recording medium,

the first unit constituted by a first area for storing first data including video or audio data and second data reproduced in synchronization with the first data,

the first program managing at least one first unit, and

the first program including managing information with regard to an assigned state of the first area.

[PROBLEMS TO BE SOLVED BY THE INVENTION]

[0021]

The present invention is made in view of the above

problems, and an object of the present invention is to enable postrecording using a plurality of user programs.

[EMBODIMENTS]

[First Embodiment]

[0069]

[Structure of AV stream] With reference to Fig. 13 through 15, the following describes a structure of an AV stream according to the present embodiment. The AV stream includes an integral number of record units (RUs). The RU is a unit of successive recording into a disk. The length of each RU is set such that, no matter how RUs constituting an AV stream are arranged on a disk, seamless reproducing and real time postrecording are ensured. The seamless reproducing is to carry out reproducing without intermitting a picture image or sound. Further, the real time postrecording is to carry out audio recording while carrying out seamless reproducing of a video image subjected to postrecording. The setting methods will be described later.

[0070]

Further, the stream is arranged such that boarders of the RUs match borders of the ECC blocks. Due to such characteristics of the RUs, even after the AV stream is written into the disk, it is possible to easily change the arrangement of the RUs on the disk, while ensuring the

seamless reproducing.

[0071]

The RU includes an integral number of video units (VUs). The VU is a unit of data, which can be independently reproduced. Thus, the VU is used as an entry point at the time of reproducing. A structure of the RU differs depending on whether the stream supports postrecording (postrecording support stream) or does not support postrecording (postrecording non-support stream).

[0072]

Fig. 14 illustrates a structure of a VU of the postrecording non-support stream.

[0075]

On the other hand, Fig. 15 illustrates a structure of a VU of the postrecording support stream. At the head of the VU of the postrecording non-support stream, a Post Recording Unit (PRU) is provided which stores postrecording (sub audio) data. The postrecording data is reproduced in synchronization with video and main audio data. Further, the PRU is divided into n number of SubPost Recording Units (SPRUs) each having a fixed size.

[0076]

N is set to a number equal to the maximum number of variations of postrecording, which is desired to be carried out on the AV stream. Here, the PRU is placed

ahead of an area for storing the main audio data. However, the PRU may be placed following the area.

[0077]

The size of an SPRU is secured based on a low audio bit rate (e.g. 64 kbps). This allows many users, who usually do not carry out, but occasionally need postrecording), to save at least some amount of storage available on a disk.

[0078]

Since postrecording input often deals with human's voice, even a low bit rate will be no problem regarding tone quality. By fixing the size of an SPRU, such an advantage is given that, even in a case where assignment and free-up of areas are repeated, so-called fragmentation (i.e., a condition under which non-assigned small areas become fragmented) rarely occurs. The following will explain more details about the case where assignment and free-up of areas are repeated.

[0080]

[AV stream managing method] A managing method of an AV stream is based on the QuickTime file format. Fig. 16 illustrates an arrangement of managing an AV stream based on the QuickTime file format. Fig. 16(a) illustrates a case of the postrecording non-support stream. Sets of video data starting from AAU, Sequence header, ... to Sequence endcode are managed as a sample. Further,

each set of Main audio data and Video data in a VU corresponds to one chunk.

[0081]

Fig. 16(b) illustrates a case of the postrecording support stream, which is basically the same as that of the postrecording non-support stream. However, the postrecording support stream differs from the postrecording non-support stream in that one SPRU is managed as one chunk. This aims to enable only a specific SPRU to be easily extracted.

[0082]

Fig. 17 illustrates an arrangement of an original program constituted by the postrecording support stream. Further, Fig. 18 illustrates an arrangement of a user program constituted by the postrecording support stream. As used herein, the original program is QuickTime managing information for managing an AV stream recorded into a disk, and the user program is QuickTime managing information which refers to an AV stream managed by an original program.

[0083]

As described above, managing information, i.e., a Movie atom, and an AV stream are the constituting elements. The Movie atom includes a video track for managing video data, a main audio track for managing main audio data, and a postrecording audio track for

managing postrecording audio data.

[0084]

The postrecording audio track includes: an assignment managing track (indicated as "assignment" in Fig. 17) for enabling an original program to manage an assigned state of each program; an area managing track (indicated as "reserved" in Figs. 17 and 18) for managing a postrecording area, which is secured in one's own program; and a use managing track (indicated as "recorded" in Figs. 17 and 18) for managing an area, which is actually used for postrecording.

[0085]

First, the assignment managing truck is described below. The assignment managing truck is created in an original program, and the number of the assignment managing truck(s) to be created corresponds to the number (N) of SPRUs in PRU(s) secured during recording of an AV stream. Each assignment managing truck associates, using a Sample table atom, each of the SPRUs under its management with a chunk and samples. In this way, addresses, sizes, and corresponding reproducing times of the respective SPRUs are managed.

[0086]

Further, the assignment managing truck manages, using an Edit list atom, whether or not each of the SPRUs has been assigned. Specifically, a section which has been

assigned is subjected to reproduction, while a section which has not been assigned is excluded from subject of reproduction. In such a manner, assigned states of the SPRUs are managed.

[0087]

By referring to assignment managing tracks, it is possible to prevent overwriting of postrecording data among different programs. In order to prevent such overwriting without using the assignment managing tracks, it would be required to check all sets of managing information of user programs, which may have referred to the same PRU, and to search for an area which has not been used. This will be a problem for an optical disk having a long seek time, regarding its process time.

[0088]

Described next is the area managing track. The area managing track is used to manage a postrecording area which is assigned to a given program. The area managing track allows it clearly to be understood, requiring no reference to an original program having assigned the program, where to record data during postrecording.

[0089]

The area managing track basically manages an address and size of an area to which data is assigned. Here, assuming that data has been already recorded, a value indicating a position where data is to be stored has

been already stored in a Sample table atom of the area managing track so that there is no need to calculate the value during postrecording.

[0090]

Finally, the use managing track is described. The use managing track manages, using a Sample table atom, samples which have been assigned by the area managing track and which have been actually stored by postrecording. Further, the use managing track specifies, using an Edit list atom, a section subjected to postrecording.

[0091]

Instead of a Sample table, it is considered that an Edit list may be used to specify a section on which postrecording has been carried out. However, in order for the Edit list to specify a section to be reproduced also with regard to postrecording data, the Sample table is used to manage the section, on which postrecording has been carried out. The use managing track may be more than one in a single program, as long as their reproducing times are not overlapped. The use managing track prevents unintended overwriting of postrecording data.

[0092]

In such a managing method, since maximally three tracks including the area managing track and the use managing track may correspond to a single postrecording

area, the same data may be triply reproduced maximally. In order to avoid such a situation, as to the area managing track and the assignment managing track, each Track enabled flag of their Track header atoms is set to 0. On the other hand, a Track enabled flag of the use managing track is set to 1.

[0093]

Further, in order to manage the track attributes, QuickTime has additional attributes as illustrated in Fig. 19. The User-defined atom in the Track atom is used to add the attributes, and its own Atom type, i.e., track property ('tkpt'), is defined. The track property is indicated as values such as 'orig' for the original track, 'prsv' for the area managing track, and 'prec' for the use managing track.

[0135]

[Processes in recording] With reference to Fig. 22, the following describes processes when a user issues a command of recording. An AV stream to be recorded is defined as the postrecording support stream having a fixed VU reproducing time with the following attributes: the bit rate of video RV is 5 Mbps; the audio sampling frequency is 48 kHz, the bit rate Ra is expressed by Ra = Rp = 256 kbps, and the version number of sub audio data N is 5. Managing information of its file system has been already stored in the RAM.

[0136]

First, a structure of the stream and a structure of successive areas are determined (Step 701). Assume that one VU includes 1 GOP of 15 frames. In this case, Te(i) is obtained in a range from 8.38 seconds or more to 8.88 seconds, when the following conditions are substituted into [Equation 6] and [Equation 7]; Rs is 20 Mbps, Ta is 1 second, Tk is 0.1 second, Rv is 5 Mbps, Ra is expressed by Ra = Rp = 256 kbps, Tvmax is expressed by Tvmax = Tvmin = approximately 0.5 second, and N is 5.

[0137]

With Tvmax of approximately 0.5 second, the conditions are satisfied when Te(i) is 8.5 seconds, and each VU includes 17 RUs. Using the MPEG-1 audio layer-II format, when the sampling frequency is 48 kHz, the reproducing time for an AAU becomes 0.024 second. Thus, one VU contains 20 or 21 AAUs.

[0138]

Further, when a maximum bit rate enabling audio reproduction is 256 kbps, the maximum size of each AAU is 768 bytes. Thus, the size of an area for each PRU is secured as (the number of AAUs in main audio data) × 768 bytes. Next, a space available for successive recording of 17 VUs is searched. Specifically, a space of 17 × Tvmax × (Rv + Ra + N × Rp) is searched by referring to a Space Bitmap stored on the RAM 102. That is, a successive

space of 56 Mbits or larger is searched. If no space is found, recording is aborted and the inability of recording is notified to the user (Step 702).

[0139]

Then, the audio encoder 117 and the video encoder 118 are individually activated (Step 703). Further, whether or not data of one ECC block (32 KB) or more has been stored in the recording buffer is detected (Step 704). When the data is stored, Steps 705 through 708 are repeated. In this case, a space for an ECC block on the next disk to be recorded is searched by referring to the Space Bitmap on the RAM (Step 705). When no space is available, a successive space available for recording of 17 VUs is searched (Step 707), and the pickup is moved to the head of the space thus found (Step 708). Then, the data of one ECC block in the recording buffer 111 is recorded into the disk (Step 706).

[0140]

When the data has not been stored in the recording buffer 111, whether or not a command of finishing the recording has been issued is checked (Step 709). If the command has not been issued, Step 704 is executed.

[0141]

When the command of finishing the recording has been issued, the following steps are executed. First, with regard to data of less than 32 KB in the recording buffer,

dummy data is added to the end of the data so that the total amount of data fills 32 KB (Step 710). Next, the data is recorded into the disk (Steps 711 through 714). Finally, the QuickTime managing information and file system managing information on the RAM 102 is recorded into the optical disk 106.

[0142]

The following describes operations of the audio encoder 117, the video encoder 118, and the multiplexer 113, which are executed in parallel to the above processes. The encoders transmit results of their encoding to the multiplexer 113, and the multiplexer stores the results into the multiplexing buffer 114. When data of one VU (i.e., (i) 1 GOP and (ii) AAUs to be reproduced in synchronization with the 1 GOP) is stored in the multiplexing buffer 114, the multiplexer 113 transmits the data of one VU to the recording buffer 111.

[0143]

When transmitting the data, in accordance with the number of AAUs in the VU, the multiplexer 113 mutiplexes 5 SPRUs available for storing AAUs having a specified bit rate. Further, the multiplexer 113 notifies the host CPU 101 that the data of one VU has been encoded. Then, the host CPU 101 updates the QuickTime managing information on the RAM 102, based on the sizes and the numbers of GOPs and AAUs, which constitute the VU.

[0144]

Fig. 23 shows states of tracks, according to QuickTime managing information which has been just recorded into the optical disk 106. The number of assignment managing tracks to be created is N, i.e., 5. Only for a first assignment managing track (indicated as PR Audio#1 (assignment) in the figure), an entire section is subjected to reproduction in an Edit list. Other assignment managing tracks (indicated as Audio#2 through #5 (assignment) in the figure) are excluded, using the Edit list, from subject of reproduction of each entire section. This is because the first area (SPRU#1) has been assigned to its own original program, while the other areas have not been assigned.

[0145]

Further, an area managing track (indicated by PR Audio#1(reserved) in the figure) is created.

[0146]

[Processes in creating user program] The following describes processes at the time of creating a user program which has externally referred to an original program. Here, assume a case where a user program to be created carries out reproduction by extracting a portion of the original program as shown in Fig. 24.

[0147]

Further, assume that a user determines a section in

the original program referred by the user program. In addition, assume that managing information related to the original program has been written into the RAM 102, and that an area for managing information related to a new user program to be reproduced has been secured on the RAM 102.

[0148]

By referring to the entire managing information related to the original program on the RAM 102, all of the 5 assignment managing tracks are checked in order to detect whether or not the specified section is available for being newly assigned. If there is found an area which has not been assigned, the following procedures are carried out. First, the area is assigned for the user program, using an Edit list of the assignment managing track. Specifically, in the Edit list, a section corresponding to the area which has not been assigned is set to subject of reproduction.

[0149]

Next, with regard to a video track and a main audio track, which correspond to the specified section, their Sample tables are copied to the user program managing information. Then, an area managing track for managing the assigned area is created.

[0150]

Specifically, assuming that data has been actually

recorded into the assigned area, a Sample table atom is established. On the other hand, if no area is found which has not been assigned, the sample tables are copied only with regard to the video track and the main audio track, which correspond to the specified section.

[0151]

Finally, the managing information of the original program and the user program is recorded into the optical disk 106.

[0152]

Fig. 25 illustrates an arrangement of managing information of an original program after creating a user program, in a case where Fig. 24(a) illustrates an arrangement of managing information of the original program before creating the user program, and Fig. 24(b) illustrates an arrangement of managing information of the created original program.

[0153]

In the present embodiment, one user program assigns one SPRU from each RU. However, when postrecording is desired to be carried out at a higher bit rate, a plurality of SPRUs may be assigned successively.

[0154]

[Processes in postrecording] With reference to Fig. 26, the following describes processes when a user issues a command of postrecording. The following processes are

carried out in both cases of a user program and an original program. With regard to an AV stream subjected to postrecording, QuickTime managing information has been written into the RAM 102.

[0155]

First, it is detected whether or not a given QuickTime movie is the postrecording support stream. When the QuickTime movie is not the postrecording support stream, a user is notified about the inability of postrecording (Step 801).

[0156]

Then, data to be reproduced is read starting from the head of VUs on the disk (Step 802). The head contains postrecording start positions. The Step 802 is repeated until an amount of data for sufficient reproducing time is read out (Step 803). Here, the "sufficient" means that data has an amount allowing successive reproduction without intermittence, even when the longest intermitted period occurs while the data to be reproduced is read out.

[0157]

Further, when postrecording areas (SPRUs) are read out, an ECC block (PRU block) including the postrecording areas are sent to the postrecording buffer 111. In order to manage PRUs in the postrecording buffer 111, a table is created by relating (i) reproducing start times (times relative to the head of the AV stream) of the respective

postrecording areas in the postrecording buffer 111 to (ii) addresses stored in the postrecording buffer 111. Then, the table is held in the RAM 102.

[0158]

Next, the video decoder 116, audio decoder 115, and audio encoder 117 are activated (Step 804). The audio encoder 117 encodes sampled audio waveforms into AAUs, and transmits the AAUs to the multiplexer 113 according to the periods of the AAUs. At this time, relative times from the head of the AV stream are added to the AAUs.

[0159]

The multiplexer 113 stores the AAUs to PRU blocks in the postrecording buffer 111, based on the times added to the AAUs. When the AAUs are completely stored so as to fill the last PRU block of the RU, the completion of encoding the PRU is notified to the host CPU 101.

[0160]

Next, whether or not a user has issued a command of postrecording is checked (Step 805). When the command is not found, in a similar manner to the Step 802, the data to be reproduced is read out until the completion of encoding the PRU is notified (Step 809).

[0161]

When the completion of encoding the PRU is notified by the multiplexer section (Step 806), an address where the PRU has been originally written is obtained.

Specifically, an address on the optical disk 106, where the PRU should be recorded, is obtained using the QuickTime managing information, based on the reproducing start times of the PRUs of the RU, which are held in the table on the RAM 102. Then, the pickup is moved to the address (Step 807), and the PRU block is recorded into the optical disk 107 (Step 808).

[0162]

When a command of finishing postrecording has been issued, moving the pickup is suspended (Step 810) until encoding currently undertaken for a PRU is completed (Step 811). Then, the PRU is recorded (Step 812), and the QuickTime managing information is finally recorded into the disk (Step 813).

[0164]

Fig. 27 illustrates states of tracks according to QuickTime managing information of an original program, on which postrecording has been just carried out. By postrecording, a use managing track (indicated by PR Audio#1 (recorded) in the figure) is added. In the case of a user program, as illustrated in Fig. 28, a use managing program (indicated by PR Audio#1 in the figure) is added by carrying out postrecording in a similar manner to the case of an original program.

[0165]

[Processes in deleting user program] The following

describes a case where a user issues a command of deleting a user program. With regard to user program(s) to which deletion has been already issued, managing information has been already written into the RAM 102.

[0166]

First, by investigating area managing tracks in managing information of user programs, original programs are listed which have assigned postrecording areas to the user programs.

[0167]

Next, the following processes are executed on the original programs thus listed up. First, managing information of the original programs is written into the RAM 102. Then, with regard to all the samples whose postrecording areas are assigned by the original programs, corresponding samples in the original programs are detected by comparing addresses of the samples.

[0168]

When the detection is completed, with regard to the original programs, assignments are freed up for postrecording areas in a section corresponding to the matched samples. Specifically, an Edit list atom of the assignment managing tracks is rewritten, and the section is excluded from the subject of reproduction. Finally, file(s) storing the user program(s) are deleted from the optical disk 106, and the managing information of the

original programs are recorded into the optical disk 106.

[0169]

[Processes in deleting original program] The following describes processes when a user issues a command of deleting an original program. Note that, an AV index file has been already written into the RAM 102.

[0170]

By referring to the AV index file on the RAM 102, an original program specified to be deleted is detected. As to an original file found as a result of detection, its link count is referred. When the link count indicates 0, the original program is to be deleted.

[0171]

[Processes in reproducing] With reference to Fig. 29, the following describes a case where a user issues a command of reproducing. As to an AV stream subjected to reproduction, QuickTime managing information has been written into the RAM 102.

[0172]

From the head of a VU specified to be reproduced on the optical disk 107, data to be reproduced is read out (Step 901). The Step 901 is repeated until an amount of data for sufficient reproducing time is read out (Step 902). Here, the "sufficient" means that data has an amount allowing successive reproduction without intermittence, even when the longest intermitted period occurs while the

data to be reproduced is read out. Specifically, the data has an amount obtained in 1 second, considering a case where an intermittence jump due to reading of an AV data becomes maximally 1 second.

[0173]

Next, the video decoder 116 and the audio decoder 115 are activated (Step 903). Then, whether or not a user has issued a command of finishing reproduction is detected (Step 904). When the command has not been issued, AV data to be reproduced is read out (Step 905). When the command has been issued, the reproducing is finished.

[0297]

[Effect of the Invention]

..., according to the present invention, by having information for managing assignment of a postrecording area, it is possible to prevent unintended overwriting when postrecording is carried out using a plurality of user programs.

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